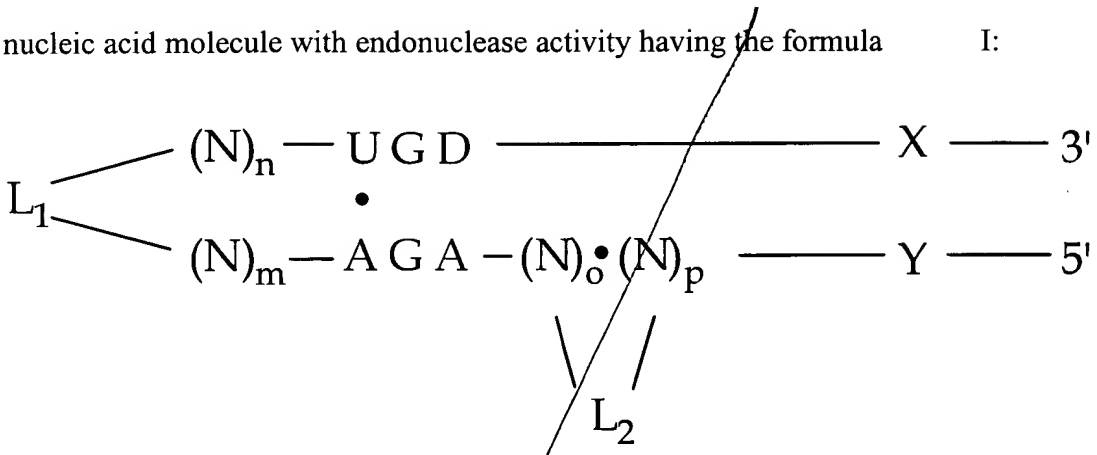
Claims

What is claimed is:

1. A nucleic acid molecule with endonuclease activity having the formula I:



wherein, each N represents independently a nucleotide or a non-nucleotide linker, which may be same or different; X and Y are independently oligonucleotides of length sufficient to stably interact with a target nucleic acid molecule; m, n, o, and p are integers independently greater than or equal to 1, wherein if $(N)_m$ and $(N)_n$ and/or $(N)_o$ and $(N)_p$ are nucleotides, (N)m and (N)n and/or $(N)_o$ and $(N)_p$ are optionally able to interact by hydrogen bond interaction; D is U, G or A; L_1 and L_2 are independently linkers, which may be the same or different and which may be present or absent, but when present, are nucleotide and/or a non-nucleotide linkers which may be a single-stranded and/or double-stranded region.

2. A nucleic acid molecule with endonuclease activity having the formula II:

wherein, N represents a nucleotide or a non-nucleotide linker; X and Y are independently oligonucleotides of length sufficient to stably interact with a target nucleic acid molecule; Z is an oligonucleotide having a nucleotide sequence selected from the group consisting of 5'-AGAUAACGUGAAGAU-3' (SEQ ID NO 53) and 5'-AAUGGCCUAUCGGUGCGA-3' (SEQ ID NO 54).

3. The nucleic acid molecule of claim 1, wherein said $(N)_m$ is selected from the group consisting of 5'-AC-3', 5'-GC-3', and 5'-CG-3' and $(N)_n$ is selected from the group consisting of 5'-GU-3', 5'-GC-3', and 5'-CG-3'.

4. The nucleic acid molecule of claim 1, wherein said $(N)_o$ is selected from the group consisting of 5'-AUUG-3', 5'-UUG-3', 5'-UUC-3', and 5'-UAG-3' and $(N)_p$ is selected from the group consisting of 5'-CAAU-3', 5'-CAA-3', 5'-GAA-3', and 5'-CUA-3'.

5. The nucleic acid molecule of claim 1, wherein L_1 is a nucleotide linker.

6. The nucleic acid molecule of claim 1, wherein L_2 is a nucleotide linker.

7. The nucleic acid molecule of claim 5, wherein said nucleotide linker is a sequence consisting of 5'-CUUAA-3'or 5'-CUAAA-3'.

8. The nucleic acid molecule of claim 6, wherein said nucleotide linker is a sequence consisting of 5'-UGUGAA-3'or 5'-GUGA-3'.

9. The nucleic acid molecule of claim 5 or claim 6, wherein said nucleotide linker is a nucleic acid aptamer.

10. The nucleic acid molecule of claim 9, wherein said aptamer is an ATP aptamer.

11. The nucleic acid molecule of claim 1, wherein L_1, L_2, or L_1 and L_2 is a non-nucleotide linker.

12. The nucleic acid molecule of claim 1 or claim 2, wherein said chemical linkage is independently or in combination selected from the group consisting of phosphate ester , amide , phosphorothioate, phosphorodithioate, arabino, and arabinofluoro linkages.

13. The nucleic acid molecule of claim 1 or claim 2, wherein said nucleic acid molecule is chemically synthesized.

14. The nucleic acid molecule of claim 1 or claim 2, wherein said nucleic acid molecule comprises at least one sugar modification.

15. The nucleic acid molecule of claim 1 or claim 2, wherein said nucleic acid molecule comprises at least one nucleic acid base modification.

16. The nucleic acid molecule of claim 1 or claim 2, wherein said nucleic acid molecule comprises at least one phosphate backbone modification.

17. The nucleic acid molecule of claim 14, wherein said sugar modification is selected from the group consisting of 2'-H, 2'-*O*-methyl, 2'-*O*-allyl, 2'-*C*-allyl, 2'-deoxy-2'-fluoro, and 2'-deoxy-2'-amino modifications.

18. The nucleic acid molecule of claim 16, wherein said phosphate backbone modification is selected from the group consisting of phosphorothioate, phosphorodithioate, and amide modifications.

19. The nucleic acid molecule of claim 1 or claim 2, wherein said nucleic acid molecule comprises a 5'-cap, a 3'-cap, or both a 5'-cap and a 3'-cap.

20. The nucleic acid molecule of claim 19, wherein said 5'-cap is a phosphorothioate modification of at least one 5'-terminal nucleotide in said nucleic acid molecule.

21. The nucleic acid molecule of claim 19, wherein said 5'-cap is a phosphorothioate modification of at least two 5'-terminal nucleotides in said nucleic acid molecule.

22. The nucleic acid molecule of claim 19, wherein said 5'-cap is a phosphorothioate modification of at least three 5'-terminal nucleotides in said nucleic acid molecule.

23. The nucleic acid molecule of claim 19, wherein said 5'-cap is a phosphorothioate modification of at least four 5'-terminal nucleotides in said nucleic acid molecule.

24. The nucleic acid molecule of claim 19, wherein said 3'-cap is a 3'-3' inverted riboabasic moiety.

25. The nucleic acid molecule of claim 19, wherein said 3'-cap is a 3'-3' inverted deoxyriboabasic moiety.

26. The nucleic acid molecule of claim 1 or claim 2, wherein said nucleic acid cleaves a separate nucleic acid molecule.

27. The nucleic acid molecule of claim 26, wherein said separate nucleic acid molecule is RNA.

28. The nucleic acid molecule of claim 26, wherein said nucleic acid comprises between 12 and 100 bases complementary to said separate nucleic acid molecule.

29. The nucleic acid molecule of claim 26, wherein said nucleic acid comprises between 14 and 24 bases complementary to said separate nucleic acid molecule.

30. The nucleic acid molecule of any of claims 1 and 2, wherein said X and Y are independently of length selected from the group consisting of 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, and 20 nucleotides.

31. The nucleic acid molecule of claim 1 or claim 2, wherein the length of X is equal to the length of Y.

32. The nucleic acid molecule of claim 1 or claim 2, wherein the length of X is not equal to the length of Y.

33. A cell including the nucleic acid molecule of claim 1 or claim 2.

34. The cell of claim 33, wherein said cell is a mammalian cell.

35. The cell of claim 34, wherein said cell is a human cell.

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36. An expression vector comprising a nucleic acid sequence encoding at least one of the nucleic acid molecules of claim 1 or claim 2, in a manner which allows expression of the nucleic acid molecule.

37. A cell including the expression vector of claim 36.

38. The cell of claim 37, wherein said cell is a mammalian cell.

39. The cell of claim 38, wherein said cell is a human cell.

40. A pharmaceutical composition comprising the nucleic acid molecule of claim 1 or claim 2.

41. A method for modulating expression of a gene in a plant cell by administering to said cell the nucleic acid molecule of claim 1 or claim 2.

42. A method for modulating expression of gene in a mammalian cell by administering to said cell the nucleic acid molecule of claim 1 or claim 2.

43. A method of cleaving a separate nucleic acid comprising, contacting the nucleic acid molecule of claim 1 or claim 2 with said separate nucleic acid molecule under conditions suitable for the cleavage of said separate nucleic acid molecule.

44. The method of claim 43, wherein said cleavage is carried out in the presence of a divalent cation.

45. The method of claim 44, wherein said divalent cation is Mg^{2+}.

46. The expression vector of claim 36, wherein said vector comprises:

a) a transcription initiation region;

b) a transcription termination region;

c) a nucleic acid sequence encoding at least one nucleic acid molecule of claim 1 or claim 2; and

wherein said nucleic acid sequence is operably linked to said initiation region and said termination region, in a manner which allows expression and/or delivery of said nucleic acid molecule.

47. The expression vector of claim 36, wherein said vector comprises:

a) a transcription initiation region;

b) a transcription termination region;

c) an open reading frame;

d) a nucleic acid sequence encoding at least one nucleic acid molecule of claim 1 or claim 2, wherein said sequence is operably linked to the 3'-end of said open reading frame; and

wherein said nucleic acid sequence is operably linked to said initiation region, said open reading frame and said termination region, in a manner which allows expression and/or delivery of said nucleic acid molecule.

48. The expression vector of claim 36, wherein said vector comprises:

a) a transcription initiation region;

b) a transcription termination region;

c) an intron;

d) a nucleic acid sequence encoding at least one nucleic acid molecule of claim 1 or claim 2; and

wherein said nucleic acid sequence is operably linked to said initiation region, said intron and said termination region, in a manner which allows expression and/or delivery of said nucleic acid molecule.

49. The expression vector of claim 36, wherein said vector comprises:

a) a transcription initiation region;

b) a transcription termination region;

c) an intron;

d) an open reading frame;

e) a nucleic acid sequence encoding at least one nucleic acid molecule of claim 1 or claim 2, wherein said sequence is operably linked to the 3'-end of said open reading frame; and

wherein said nucleic acid sequence is operably linked to said initiation region, said intron, said open reading frame and said termination region, in a manner which allows expression and/or delivery of said nucleic acid molecule.